THE GEOMETRY OF FORCES.

Geometrie der Kräfte. By H. E. Timerding. Pp. xii+381. (Leipzig: B. G. Teubner, 1908.) Price 16 marks.

IN this admirable volume Prof. Timerding gives a systematic and original treatment of the geometry of forces and force-systems in which for the first time, so far as we are aware, an adequate knowledge of modern geometrical research has been utilised in a text-book of mechanics.

Ever since the great work of Plücker, that large and most attractive department of mathematics known as the geometry of the linear complex has been found to be intimately connected with the geometry of forces. It is sufficient to recall the fact that whenever six forces applied to a free body are in equilibrium, the forces must lie respectively on six rays of a linear complex. In chapters viii. and ix. of Timerding's book now before us we have an admirable treatment of the application of the theory of the linear complex to the theory of systems of forces. The many interesting matters set forth in these pages show how greatly the advancement both of the geometrical theory and the dynamical theory is promoted by their association.

The statical and dynamical significance of the linear complex is closely connected with the fact that each ray of the complex is reciprocal to that screw of which the axis is the axis of the complex, while the pitch of the screw is the parameter of the complex. Many of the geometrical properties of the complex follow directly from this general principle. For example, on p. 107 it is shown that four linear complexes have two real or imaginary rays in common. This is an immediate consequence of the fact that one cylindroid can always be found of which every screw is reciprocal to any four given screws. As there are two screws of zero pitch on the cylindroid, these lines are, of course, the two common rays of the four linear complexes defined as being reciprocal to each of the given screws. We congratulate Prof. Timerding on his recognition of the proper place for the linear complex in the forefront of a text-book on the geometry of forces.

The theory of screws has received in this volume a treatment even more ample than that which it has already received in the works of Fiedler, Schell, Budde, Minchin, and more recently in the "Encyclopädie der mathematischen Wissenschaften." The excellent work of Harry Gravelius, "Theoretische Mechanik Starrer Systeme," contains a complete account of the theory of screws up to the date of its publication in 1889. Much of the work done on the subject in the succeeding decade has been available for the "Geometrie der Kräfte." It may, however, be remarked that certain developments of the theory which have appeared since 1900 have not been included in Prof. Timerding's volume. The theory of screw-chains, by which the theory of screws has been extended to any material system, is also not discussed. A suggestive reason for this omission is given in the preface (p. vii), where Prof. Timerding says that, in his opinion, the theory of screw-chains would require a new and voluminous treatment of the whole of mechanics in which the rigid body would appear as the first element.

Observing that the laws for the composition of twists and wrenches are identical, the author, as others have done, uses the word *dyname* to signify either a twist or a wrench. For a large part of the subject the use of the abstraction signified by the word dyname is very convenient, and considerable use has been made of the important labours of Study on the geometrical theory of dynames.

In an interesting chapter on "Die Reyeschen Strahlencomplexe" the author brings into its due prominence the fundamental importance of the "Geometrie der Lage" in kinematics. This chapter contains many admirable theorems, and we could only wish that such instructive and beautiful ideas as are here set forth were more generally introduced into the teaching of mechanics. Due acknowledgment is made throughout the work of the important contributions to the geometrical theory of forces by the late Prof. Charles J. Joly.

The chapter on the cylindroid may be specially commended, and prominence is given to the theorem that the projections of any point on the generators of a cylindroid lie on an ellipse. We may, however, note that the proof here set forth is not that by which the theorem was discovered, as shown in the original volume on the theory of screws published in 1876.

A sufficient account is given of the various systems of screw coordinates, and, following the analogy of the resolution of forces, Prof. Timerding uses notation which divides the coordinates of a screw into two groups of three each. It is, however, often convenient to use the six symmetrical coordinates of a screw referred to six co-reciprocal screws.

We are glad, indeed, to commend this most excellent work to the attention of teachers and students of theoretical dynamics. We are sure that if the book were translated into English it would form a very valuable supplement to the existing English books. It would give the student an adequate idea of the extent to which modern geometrical theory and the theory of forces act and react on each other to the vast benefit of both. ROBERT S. BALL.

THE DISTRIBUTION OF GOLD ORES.

Gold: Its Geological Occurrence and Geographical Distribution. By J. Malcolm Maclaren. Pp. xxiii+687. (London: *The Mining Journal*, 1908.) Price 25s. net.

DR. MACLAREN begins his preface with the remark that "the writer who would add one more treatise to the literature of the study of ore-deposits must needs show justification." Any apology for the publication of his useful book is, however, quite unnecessary, for the increase by four times of the gold yield of the world during twenty years has been attended by a voluminous and scattered literature. Students of mining geology will be grateful to any author who undertakes the great labour of compiling a summary of recent work on gold and its distribution.

The longest and most valuable section of Dr. Maclaren's book is occupied by an account of the geological

structure and mining history of all the chief goldfields of the world. This part of the work occupies 544 pages. The goldfields are classified by continents. Those of Europe are described first, and in proportion to their economic importance receive longer notice than those of Australia and South Africa. The longest section is that on the goldfields of North America. Each field is noticed separately; the descriptions are necessarily short, but they are concise, and are accompanied by useful reference to recent literature. The minor fields are described at relatively greater length than the others; and thus Kalgurli, with its "Golden Nile," is dismissed in four pages, including a full-page map and another figure. This distribution of space is, however, probably the most useful, as the less-known fields are often very instructive and their literature is less accessible. The author has travelled extensively, and his accounts of many fields have the advantage of personal knowledge and original information. The descriptions of the fields are therefore inevitably of unequal merit.

Among the most interesting sections are those on the mines of New Zealand—though as a New Zealander, it is strange that the author places Reefton in Westland, and spells the name of the founder of the New Zealand school of mining geologists Uhlrich—of Queensland (the author was once on the staff of its Geological Survey), and of Mysore. The historical introduction to the Mysore gold mines is of especial interest, and the author rejects the view that the ancient mines there can have been those from which Solomon and the Phœnicians obtained their supplies of gold. Dr. Maclaren remarks that India was then a civilised State, which needed more gold than it produced; and the Israelites could only have obtained gold there by barter, for which they had nothing to offer. This conclusion, therefore, strengthens the view that the Ophir of the Phœnicians must be in southern Africa, and that the gold probably came from the prehistoric mines of Rhodesia.

Dr. Maclaren's account of the separate goldfields is preceded by an introduction on the chemical and physical properties of gold, on natural and artificial compounds of gold, and on the theories of the formation of gold ores. The speculative section of this introduction is remarkable for the author's advocacy of somewhat extreme positions. Thus he denies the origin of any important ore deposits by other agencies than meteoric waters. He admits that there may be some magmatic water; but even when he allows that the gold is due to magmatic emanations, he holds that the water in which it is dissolved comes from a superficial source. He also holds to the once popular view that alluvial gold and gold nuggets are formed by growth *in situ* in the gravels from percolating goldbearing solutions. He defends this view especially on the ground of the crystalline character of much alluvial gold; he quotes competent authorities who deny this fact, but affirms it from his own experience. The author does not explain why, on this precipitation theory, nugget formation is so local, and why the nuggets are so constantly found just below the outcrop of reefs containing nuggety patches of gold. He

admits that the nuggets of Western Australia are derived from gold-quartz veins, and the evidence for the similar origin of the nuggets from Victoria—which contains the most famous of nugget-yielding goldfields—seems to the writer overwhelming.

Another doubtful hypothesis advanced by the author is the absence of any undoubted, valuable pre-Cretaceous placer deposit. He rejects, or quotes with apparent approval those who reject, the alluvial origin of the gold in various Mesozoic, Palæozoic, and Archæan conglomerates and sedimentary deposits; and he then argues that the absence of pre-Cretaceous detrital gold is due to the rocks having been lowered into a zone saturated with alkaline waters which removed the gold in solution and re-deposited it in veins.

Though many geologists may be disposed to differ from the author in some of his conclusions as to the formation of gold ores, they will be no less grateful to him for this valuable and trustworthy summary of the voluminous gold literature issued during the past twenty years.   J. W. G.

SWINE IN AMERICA.

Swine in America. A Text-book for the Breeder, Feeder, and Student. By F. D. Coburn. Pp. xv+614. (New York: Orange Judd Co.; London: Kegan Paul and Co., Ltd., 1909.)

JUST as it might be said of the British fat bullock that he has followed the turnip, so it might be said of the American fat hog that he has followed the corn, *i.e.* Indian corn. In the United States there are 56 millions of swine—there are only three and a half millions in the United Kingdom—and far more than half these are to be found in the great corn States which are drained by the Mississippi and its tributaries. Iowa comes first with $8\frac{1}{2}$ millions, and Illinois and Nebraska next with $4\frac{1}{2}$ and $4\frac{1}{4}$ millions. Altogether there are about eighty million pounds' worth of swine in the United States, the duty of which it is to convert corn and other crops and by-products into more marketable commodities, and eventually to feed, not only the Americans, but also some part of the industrial population and the armies and navies of the rest of the world.

An industry so vast can do with many a text-book, and Mr. Coburn has produced one for those who breed, rear, and feed the raw materials for the American packing houses. Many experiments have been carried out in the States on the rearing and fattening of swine, and the gist of these is embodied in Henry's "Feeds and Feeding," which, however, is a book dealing rather with principles than with the details of management, and a book, therefore, for the student rather than for the farmer. Mr. Coburn's is a farmer's book. He has collected Henry's and many other data, and set them forth in such a way that the nutritive effect and economic value of every important feeding stuff and by-product is dealt with, whether these foods are fed separately or with others. The effects of bulky and succulent foods and of concentrates, and of these consumed separately and jointly, are fully considered. Thus, for instance, a farmer